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ABSTRACT

This guide is intended for use in teaching a course in construction planning and design. During the course, students learn how to use the project delivery process to design low-rise buildings and civil projects, simulate working in an architecture/engineering office that is organized into design teams, and use various management tools to monitor project delivery and ensure high levels of professional performance. The first two sections discuss the guide's development within the framework of North Carolina's efforts to improve technological literacy and the guide's place as part of an instructional system. A list of the course's major objectives and a course outline are provided next. The remainder of the guide consists of learning modules on the following topics: the fundamentals of construction planning and design, planning and design procedures, site selection, design and engineering of low-rise structures, preparation of working drawings, procedures for writing specifications, and methods of designing civil structures. Each module includes information about the length of time needed to complete the module, an introduction to the instructional content to be covered in class, performance objectives, a day-by-day outline of student learning activities, related diagrams and worksheets, and lists of suggested textbooks and references. (MN)

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The North Carolina Technology Education Curriculum is the product of a curriculum redirection process begun in the early seventies. As in any change process, many individuals have contributed their time and energies to provide North Carolina students with a curriculum designed to meet their needs to be technologically literate adult citizens. The following are recognized for their vision and leadership in setting the direction for Technology Education in North Carolina schools.

Members of the N.C. Curriculum Study Taskforce who charted the course for technology education in North Carolina schools. Their study report and recommendations provided the direction for a change in the identity of the discipline and a total redirection of the curriculum.

Members of the N.C. Curriculum Committee who validated the Technology Education Curriculum Guide as appropriate study for assisting students in understanding technological systems impacting on their lives. Further, industry representatives of the committee verified the appropriateness of suggested activities reflective of practices in construction, communications, manufacturing, and transportation.

N.C. Technology Education Association who provided a forum for redirection of the discipline. It was the association that led the profession in changing identity to technology education. The association also provided opportunities for professionals to develop competence in the classroom delivery of technology education through the sponsorship of in-service programs.

Individual technology education professionals who gave leadership to other professionals in the curriculum change process. These professional leaders piloted many technology education activities in their classrooms and served as role models for other professionals.

Members of the N.C. Council of Technology Teacher Educators who provided insite and support throughout the curriculum redirection process.

Indiana curriculum developers who provided curriculum materials adopted and adapted for North Carolina Technology Education programs.

INTRODUCTION

The North Carolina Technology Education Curriculum is a program to meet every citizen's need to be technologically literate. Some basic assumptions underlie the program, and these can be divided into content assumptions, and learner assumptions.

The curriculum was developed using the belief that the appropriate content for the field is technology, and its impact on individuals and society. It was further assumed that the content is best organized around human productive systems that have been used, are now being used, and will, most likely, continue to be used. These universal systems are communication, construction, manufacturing, and transportation. Finally, it was assumed that this content can best be addressed from a systems approach with its inputs, processes, outputs, feedback, and goals/restraints.

The curriculum was further based on the assumption that education should meet the needs of individuals and the human requirements of society. It was assumed that each person living in a technological society should have a basic understanding of and the ability to assimilate the knowledge about technology. People it was assumed, should be able to interact with the technological nature of society and help impact the type of future new technologies can provide. Additionally people should be able to be contributors to a society in their several roles, including citizen, voter, investor, consumer, worker, and leader.

These assumptions caused the curriculum to be developed in such a way as to:

1. Provide an overview of technology first, allow for more indepth study in specific technological areas, and culminate with synthesis activities.

2. Be more teacher-directed, content-centered in early courses, and highly, student-directed, process centered in advanced courses.

3. Involve problem-solving and group activities of all courses.

4. Stress the how and why of technology and its relationship to our quality of life.

5. Be activity-centered learning, with the content being used to determine the appropriateness of each activity selected.

6. Be equally important to young women and young men, both of which must function in a technological society.

Finally, the curriculum was developed to be descriptive rather than prescriptive. The materials describe what to teach and suggest ways of teaching the content. At no time are daily activities prescribed in such a way to preclude individualizing the presentations to meet local conditions.

THE CURRICULUM GUIDE IN AN INSTRUCTIONAL SYSTEM

Each course in the North Carolina Technology Education Curriculum is seen as a dynamic activity involving a complete instruction system. This system generally includes seven components: the teacher, the students, a texbook when available, the curriculum guide, laboratory sheets, apparatus, and a reference library.

THE TEACHER

The teacher plays the primary role in the system. This role entails being a curriculum developer. The teacher chooses the points to emphasize and to evaluate. Care should be taken to insure that the coverage of the subject is comprehensive. You should resist "picking and choosing" only modules and activities that are the most interesting, most familiar, or the easiest to implement. All modules and activities should be included. However, you are encouraged to redesign or replace activities with your own activities that contain equivalent content.

As a technical expert, the teacher gives presentations, demonstrations, and asks questions about the subject matter. Safety information, and the demonstration of teaching/learining activities, are the responsibility of the teacher.

The teacher is an instruction manager. Managers plan, schedule, direct, and control activities. The teacher, perhaps in cooperation with students, plan the instruction by identifying the instructional goals. The activities to reach these goals are scheduled. Through presentations and application activities students are directed through the construction activities. Finally, the student's work and the teacher's management is controlled through various forms of evaluation. Since evaluation instruments should be designed to measure success in reaching the goals, these instruments should be prepared by the teacher.

The teacher is the creator of the teaching/learning environment. It is highly recommended that you create a "role playing" environment. In addition to having students do tasks that simulate construction, have them play the role of workers, managers, and owners. For example, refer to a group of students as a "work crew" or "survey party" with job titles, rather than as students who carry out assigned tasks. Help them visualize themselves in their roles. The teacher can become a job superintendent, owner, or government officer, who approves the "work crew's" job.

THE STUDENT

The target population is made up of middle-junior high or high school students. The students will often work in groups of from three to five. Their responsibilities include reading the textbook assignments, doing the worksheets as homework, and completing the activities.

THE TEXBOOK

A textbook should be selected for the course and each student should have one. A textbook contains the body of knowledge about industrial technology. It should be selected to meet the appropriate reading level, and be written in an interesting way with numerous illustrations.

THE CURRICULUM GUIDE

The curriculum guide is to be used to help plan your instruction. The introduction consists of a structure for the content and a description of an instructional system with suggestions on how to use it.

The remainder of the curriculum guide briefly describes the modules. Each module consists of an introduction, objective(s), and a description of the activities. The description of the activities includes a schedule, presentation titles, application activities, and presentation titles, references, and safety guidelines. Suggestions for getting prepared and carrying out the activity are found in the teacher activity sections.

Suggestions for a variety of optional activities may also be found throughout the curriculum guide.

THE APPARATUS

Often the course guide contains plans for specialized apparatus useful in teaching the course. Drawings will be placed with the activity in which they are used. You can use the drawings to construct the apparatus.

THE REFERENCE LIBRARY

Some courses require student reference books. The titles of these are included in the reference library and copies should be purchased for laboratory use.

DAILY LESSON PLANS AND EVALUATION

The planning of daily activities and an on going evaluation system are th teacher's responsibility and rightfully so. Each student should adapt activities and presentations to insure they help students develop the identified concepts within local conditions. The curriculum guide was designed to help you, the local professional, present a relevant, exciting course. Good luck!

INTRODUCTION

Purpose and Rationale

The fascinating study of architecture/engineering (A/E) encompasses a sensitivity to design, a knowledge of materials, construction techniques, and principles that govern their use, a skill in drawing, and an understanding of how the delivery of the project is managed. It is the combination of these abilities that yields the outstanding A/E of today's world. These A/Es design quaint lakeshore cottages, modern churches, huge dams, bridges, highways, and massive high-rise structures that meet the needs and wants of our society.

In "Construction Planning and Design" students use the Project Delivery Process (PDP) to solve design problems and provide professional services. They work in design teams similar to those used in actual practice and develop an ability to work effectively in groups. A managed system is used to help team members develop corporate loyalty and professional responsibility.

"Construction Planning and Design" is directed toward people who are interested in solving problems related to designing constructed projects. Students learn about how to use the Project Delivery Process" (PDP) to design low-rise buildings and civil projects. Students simulate working in an A/E office that is organized into design teams (consisting of students) and under the direction of a project manager (teacher); job titles are written, and working conditions and general duties are simulated. Management tools such as project delivery schedules, project progress reports, graphic standards manuals, etc. are used to monitor the project delivery and to insure a high level of professional performance by the design teams.

COURSE ORGANIZATION AND TEACHING STRATEGY

The course consists of 7 modules. They are:

1. Introduction to Construction Planning and Design
2. Planning and Design Procedures
3. Selecting the Site
4. Designing and Engineering Low-rise Structures
5. Preparing Working Drawings
6. Writing Specifications
7. Designing Civil Structures.

The principles used to sequence the course follow.

1. Simple to Complex
   a. Students are first introduced to the kinds of structures, the design studio, and key terms.
   b. They learn about the Project Delivery Process.
   c. Next, students design a low-rise structure.
   d. Finally, the design teams design high-rise and civil projects that are part of a major development.

2. Known to Unknown
   a. The class first distinguishes between the kinds of structures.
   b. They next design a landscape feature.
   c. A low-rise structure is designed next.
   d. Finally, unfamiliar civil structures are designed.

STRUCTURE OF CONTENT

A pictorial representation of the two dimensional structure is shown in Figure 1. The horizontal axis shows the kinds of constructed projects. There are two categories:

1. Buildings
   a. High-rise
   b. Low-rise

2. Civil
   a. Roadways
   b. Bridges
   c. Dams
   d. Towers
   e. Tunnels
   f. Pipelines.

The vertical dimension illustrates the parts of the Project Delivery Process. They are:

1. Selecting the site

2. Designing and engineering the project
   a. Writing the program
   b. Developing design schematics
   c. Developing the design
      (1) engineering
      (2) building models
      (3) estimating costs

3. Preparing construction documents
   a. Working drawings
   b. Specifications

Laced through the above practices is a management system that plans, organizes, directs and, controls the delivery of the professional service.

OBJECTIVES

This course provides students with knowledge and skills related to designing building and civil structures. An instructional strategy was developed to prepare students to:

1. Distinguish between the kinds of building and civil structures.

2. Use the Project Delivery Process to design and document low-rise buildings and civil structures.

3. Work cooperatively in design teams to deliver professional services.

4. Use management methods to plan the project delivery system, organize the design teams, schedule the work, and monitor its progress.

CONSTRUCTION PLANNING AND DESIGN

			Buildings		MODULE I Civil Structures					
PROJECT DELIVERY PROCESS		Manage A/E Firms	Low-rise	High-rise	Roadways	Bridges	Towers	Dams	Tunnels	Pipelines
Select Site										
DESIGN	Programming									
	Schematics		MODULES III - VI							
	Study Models	MODULE II								
DEVELOP	Engineering				MODULE VII					
	Presentation Models									
	Estimate Costs									
DOCUMENT	Working Drawings									
	Specifications									

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COURSE OUTLINE

Module Number	Title and Content	Time (Days)
1.	Introduction to Construction Planning & Design A. The design studio B. Designing vs. engineering C. Designing buildings vs. civil structures	5
2.	Planning and Design Procedures A. Acquiring the project B. Organizing the project C. Project program phase D. Schematic design phase E. Design development phase F. Construction documents stage G. Construction phase	10
3.	Selecting the Site A. Site criteria B. Gathering information C. Preparing reports	5
4.	Designing and Engineering Low-rise Structures A. Organizing the project B. Project program phase C. Schematic design stage D. Design development phase	15
5.	Preparing Working Drawings A. Types of plans B. Drawings and details C. Elevation schedules	15
6.	Writing Specifications A. Bidding requirements B. Construction standards C. Contract limits	5
7.	Designing Civil Structures A. Selecting the site B. Programming C. Developing designs D. Preparing construction documents	25

The following is a brief description of Modules 1-7.

Module 1

In the orientation to the course, students learn about where architects and engineers work (design studios), the kinds of professional services they provide (programming, design, engineering and construction management), and the categories of constructed structures (buildings and civil).

Module 2

The Project Delivery Process (PDP), office organization, and management documents are introduced at this point. A simple construction project, such as a park bench, is used to familiarize the designers with the PDP and with office management techniques.

Module 3

Student architects use site selection technology to locate and choose an appropriate site for a low-rise structure that will be designed in the following module.

Module 4

In this module, a low-rise building project is acquired, organized, and designed. Principals in the design firm negotiate an agreement on the professional services that are to be provided. Design teams program to project, develop schematics, develop designs, and produce construction documents for the structure. The best design is presented to the client.

Module 5

In Module 5, design teams prepare a set of drawings for the low-rise structure they designed in the previous module. The set of drawings includes a site plan, footing and foundation plan, floor plan, details and elevation schedules.

Module 6

Specifications are used as guides to contractors in estimating, bidding and building the project. In this module, the designers prepare three sections for the book of specifications; Bidding Requirements, Contract Limits, and Construction Standards.

Module 7

The final module is designed to help student architects/engineers solve problems on a larger scale. A high-rise structure, dam, bridge, road tunnel, pipeline, and electrical transmission line, is to be located on a site and designed. The projects will make up a recreational area named "Resort City". The class is divided into design teams, and programs for the individual structures and site information sheets, are distributed. The design teams are to locate and design the assigned structures. The teams are expected to coordinate their projects in ways that enhance the total design.

MODULE: 1 : Introduction to Construction Planning and Design

LENGTH: 5 DAYS Construction CLUSTER

In this introductory module, students learn about the architectural/ engineering office which consists of a reception area, reference area, print-making facilities, production space, and conference areas. The production area is where program reports are prepared, designs are developed, construction documents are produced and reproduced, and models are built. It is often referred to as a **studio**. In small firms, all of the activities may take place in functional areas of one open space. Larger firms may reduce one large space into specialized work spaces with room dividers or walls.

Construction projects are designed by either architects or engineers. Architects develop plans for buildings, shopping centers, and community developments. Engineers design bridges, dams, highways, and utility systems. Sometimes, the architect and engineer work as a team. The architects in charge of a shopping center design are responsible for the **master plan** and depend on engineers to design certain parts of the project. Electrical engineers design the electrical system and civil engineers design the drainage of the site. Architects are very interested in how a structure looks while engineers are most concerned with its function and strength.

Constructed structures are built where they are used. Materials, workers, and other resources, are brought to the site where construction occurs. For this module, structures are categorized as buildings or civil structures.

1. Buildings are divided into high-rise or low-rise.

2. Civil structures include bridges, roadways, dams, pipelines, tunnels, and towers.

OBJECTIVES

Upon completing this learning module, each student should be able to:

1. Describe a design studio by naming the specialized work spaces in the school studio and describing the kind of work that is done in each space.

2. Distinguish between architects and engineers by describing the nature of the projects they typically design and other professional services that each provides.

3. List two categories and eight subcategories of constructed structures.

4. Look at a collection of pictures and categorize them into one or more of the subcategories.

CALENDAR

DAY	ACTIVITY
1	Brief students on the scope of the course and classroom management information.
2-3	Tour the design studio.
4	Distinguish between architects and engineers.
5	Categorize the kinds of structures.

PRESENTING THE MODULE

DAY	ACTIVITY
0	Prepare for this module by:

1. Visiting a small and a large architectural office. While visiting with the host, listen to the terminology used to describe the spaces and the. professional services provided.

2. Ask the host to distinguish between the work of architects and that of engineers. Visit with an architect and an engineer. Ask them about their work and their college preparation.

3. Find reading materials in encyclopedias, books, and magazines related to high- and low-rise buildings, bridges, roadways, dams, pipelines, tunnels, and towers.

4. Locate pictures in magazines showing the projects listed above.

5. Produce slide series on one or more of the projects listed above.

6. Prepare response forms for the student activities on which they categorize, label, or design structures relevant to the topic being discussed.

1 Describe the "Course Scope".

1. Develop an understanding of, and skill in using, the Project Delivery Process (PDP).

2. The PDP starts by initiating a project. (Agreement with owner to provide professional service.)

3. The PDP ends with preparation of construction documents.

4. It always includes four phases. They are:

   a. Programming
   b. Schematic Design
   c. Design Development
   d. Construction Document.

5. Most firms also provide site selection and construction management services.

PRESENTING THE MODULE

DAY	ACTIVITY

Introduce the activity.

1. Distribute example sets of completed work that was done by architects and/or engineers that represent each phase of the PDP.

2. Ask students to describe the kinds of decisions that are made at each phase.

3. Determine the kinds of skills that the A/E demonstrated on each project.

2-3 Give a guided tour of the design studio.

1. Provide a display of examples of work, and the equipment and supplies used to produce presentation materials for each phase of the PDP.

2. Demonstrate simple ways to:

   a. Graphically describe alternative building sites
   b. Prepare a program presentation
   c. Make schematic designs
   d. Develop designs
   e. Draw and reproduce working drawings
   f. Write and duplicate specifications.

3. Use exercises to involve students in operating the equipment and using the processes. These exercises may include:

   a. Make a print of a drawing
   b. Experiment with a computer to do a simple drawing
   c. Use templates and drawing instruments to make a simple drawing
   d. Use felt markers to do a simple color rendering
   e. Scan and find specific information on drawings, in specifications, or in a project program, etc.

4 1. Give a brief presentation that makes the distinction between an architect and engineers. Include the concepts of:

   a. Differences in preparation
   b. Concern for appearance or strength
   c. Kinds of projects they design
   d. Design process used.

DAY	ACTIVITY
	2. Direct a group activity in which the group does one of the following: a. Go through a "tear" file and select pictures that depict the four concepts described above. b. Sort through a collection of presentation material and determine if they were produced by an architect or engineer. c. Review some reading materials selected by the teacher that describe the two professions and have the student groups give a brief summary of what they learned.
5	Discussion: How structures are categorized - buildings and civil structures. Show a slide series or use other visuals to illustrate each category.

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APPENDIX

INSTRUCTIONAL MATERIALS:

1. Teacher-made visuals (i.e. transparencies, slides, picture essays, models) that illustrate the buildings and civil structures described in the module.

2. Set(s) of drawings for an example of each structure covered in the lessons.

3. Teacher-developed response forms used during audio/visual presentations and application activities.

CONSTRUCTION PLANNING & DESIGN

MODULE: 2 : Planning & Design Procedures

LENGTH: 10 DAYS Construction CLUSTER

Project Delivery (PD) consists of six processes. They are: Programming the Project, Selecting the Site, Developing Schematics, Developing Designs, Preparing Construction Documents, and Construction Management.

The purpose of this module is to cover the four phases of the Project Delivery Process (PDP), (i.e. programming, making schematics, developing designs, and preparing construction documents), used by architects/engineering (A/E) firms as they create buildings and civil projects. In most construction design projects, the initial program development and design are performed by an architect. In the ideal situation architects work closely with other members of the design staff from the initiation of the idea through the final stages of construction.

Solving technical problems is the easiest thing to do in a consulting practice. It is the business aspects of running the firm that gives professionals the most trouble. A design firm operates under some special rules that come from the nature of the creative process.

1. It is task-oriented.
2. Decision-making dominates the work.
3. The bottom line is quality.

Therefore, special management methods and personnel structures are used. The bottom line for A/E is quality professional performance. Professional performance is measured in terms of:

1. Matching the solution to the need.
2. Depth and quality of the solution.
3. Appearance and effectiveness of presentation materials.
4. Success in leading (following) the client during the process.

This module is designed to walk students through four phases of the PDP while working in a managed professional context. Students simulate procedures and methods designed to improve productivity and client relations.

The construction project is to be a simple structure designed by a project team.

OBJECTIVES

Upon completion of this learning module, each student should be able to:

1. Define and give examples of the following practices:
   a. Selecting the site
   b. Developing schematic designs
   c. Developing the design
      (1) Building models of the project
      (2) Estimating cost of project
   d. Preparing construction documents
      (1) Making working drawings
      (2) Writing specifications.

2. Describe the kinds of ownership used by A/E firms and discuss their advantages and disadvantages.

3. List and describe each activity area by stating its primary responsibility.

4. List the levels of authority and the primary responsibility of each level.

5. Select a site, develop a program, do a schematic, develop a design, and document a simple project such as a lawn bench or picnic table.

6. Simulate working in a managed A/E office.

7. List and describe the personnel who deliver A/E services.

PRESENTING THE MODULE

DAY	ACTIVITY
0	Select the example project to be the focus for the module. A park bench, doghouse, or picnic table are all good choices. Keep the structure simple because only 10 days are used to select the site, design, engineer, draw, and specify the structure. Plan how to organize your class into project teams. Have the teams select a project team leader (PTL). Incorporate job titles, appropriate terminology, and management procedures throughout the module.
1	Give a presentation on designing structures in an organized and managed A/E firm. Emphasize: 1. The Project Delivery Process (PDP). 2. How human resources are organized into project teams. Introduce the design project. Organize the staff (students) into project teams with 3-5 members. Distribute the program for the design project. Join a project team and participate in selecting a project team leader (PTL). Study and discuss the program for the project. Be certain team members understand the needs of the structure.
2	Describe the procedure and considerations used in selecting a building site. Distribute descriptive material such as maps, topographical surveys, soil surveys, zoning maps, etc. that describe potential sites for the project. Distribute Site Selection Forms. Direct students to consider the site information and the project program. Then, they select the most suitable site and explain their decision. Design teams study the site information. Select the most suitable site. State why your choice is the best.

PRESENTING THE MODULE

DAY	ACTIVITY
3	Present the design process. Include: 1. Developing the program 2. Creating schematic designs 3. Developing designs 4. Presenting and selecting ideas Refer to the project program Describe brainstorming Direct the project team to brainstorm preliminary solutions to the problem, then, select the 2-3 best ideas. Students get into their project design teams and use brainstorming to generate a number of preliminary ideas. From the list, select the best ideas and sketch them out.
4	Use drawings or sketches to illustrate how rough ideas are refined into more workable plans called schematics. Emphasize: 1. Using liberal drawings 2. Drawing to scale 3. Judging ideas 4. Combining ideas 5. Comparing ideas to the project program 6. Rejection is not failure. Direct students to make bubble drawings and scale drawings. Have them judge, combine, compare, and reject ideas in order to get the best idea. Students get into your project team and prepare schematics of the ideas. Focus on getting high quality solutions to the problem.

DAY	ACTIVITY
5	Use examples to show how an idea can be analyzed in terms of the function, site, structure, and cost. Direct students to divide the responsibility. One or more team members should analyze the function, site, structure, and cost. The results of the analysis should be written down. Students join the project team. Accept the responsibility to develop the designs in regard to function, site, structure, and cost. Write down the results of their development.
6	Describe how designs are presented to obtain client approval. Use examples of presentation materials such as models, visuals, renderings, drawings, etc. Demonstrate how to make a simple study model of the solution. Direct students to prepare presentation materials. Additional materials can be made at home as homework. Students decide what presentation materials are needed, then prepare them. They build a simple study model of the final solution.
7	Describe how solutions are selected. Include the kinds of decisions a client may render. They may accept, combine, or reject the solutions. Use a Design Quality Profile to evaluate solutions. Students give a presentation to the client. The client decides to accept, combine, or reject the designs. Complete a Design Quality Profile on each idea.

DAY	ACTIVITY
8	Give a brief illustrated lecture on "Construction Documents." Emphasize working drawings. Include: 1. The kinds 2. The purposes 3. Examples of how they are produced 4. Information to be found in them. Direct students to their project teams. The project team leader (PTL) should assign the drawings to the drafters. Each drafter makes a different drawing (sketch). Students work as members of a project team and produce the working drawing assigned to them by the team leader. The drawings are to be sketched on graph paper.
9	Give a brief lecture/discussion on, "Writing Specifications". Include: 1. The kinds of specifications 2. Why they are written. Direct project team to write the "Construction Standards" section. If appropriate, include: 1. The scope of the project 2. The materials to be used 3. The methods to be used 4. The equipment to be installed. Students write the part of the construction standards that are assigned by the project team leader.
10	Summarize the major steps of the PD process and discuss the results that come from each step. Review how A/E firms are organized and structured to provide professional services.

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Design Process

_____. Architects Handbook of Professional Practice. # 11 "Project Procedures", pp. 6-9.

Henak, Richard M., Exploring Construction Technology. pp. 73-81.

Lux, Donald, et.al., World of Construction. pp. 37-39.

Organizing the Project

_____. Architects Handbook of Professional Practice. # 11 "Project Procedures", pp. 1-6.

Selecting the Site

Henak, Richard M., Exploring Construction Technology. pp. 50-54.

APPENDIX

INSTRUCTIONAL MATERIALS:

1. Prepare transparencies and other visuals used to communicate the PD process and the concepts related to managing and organizing A/E firms.

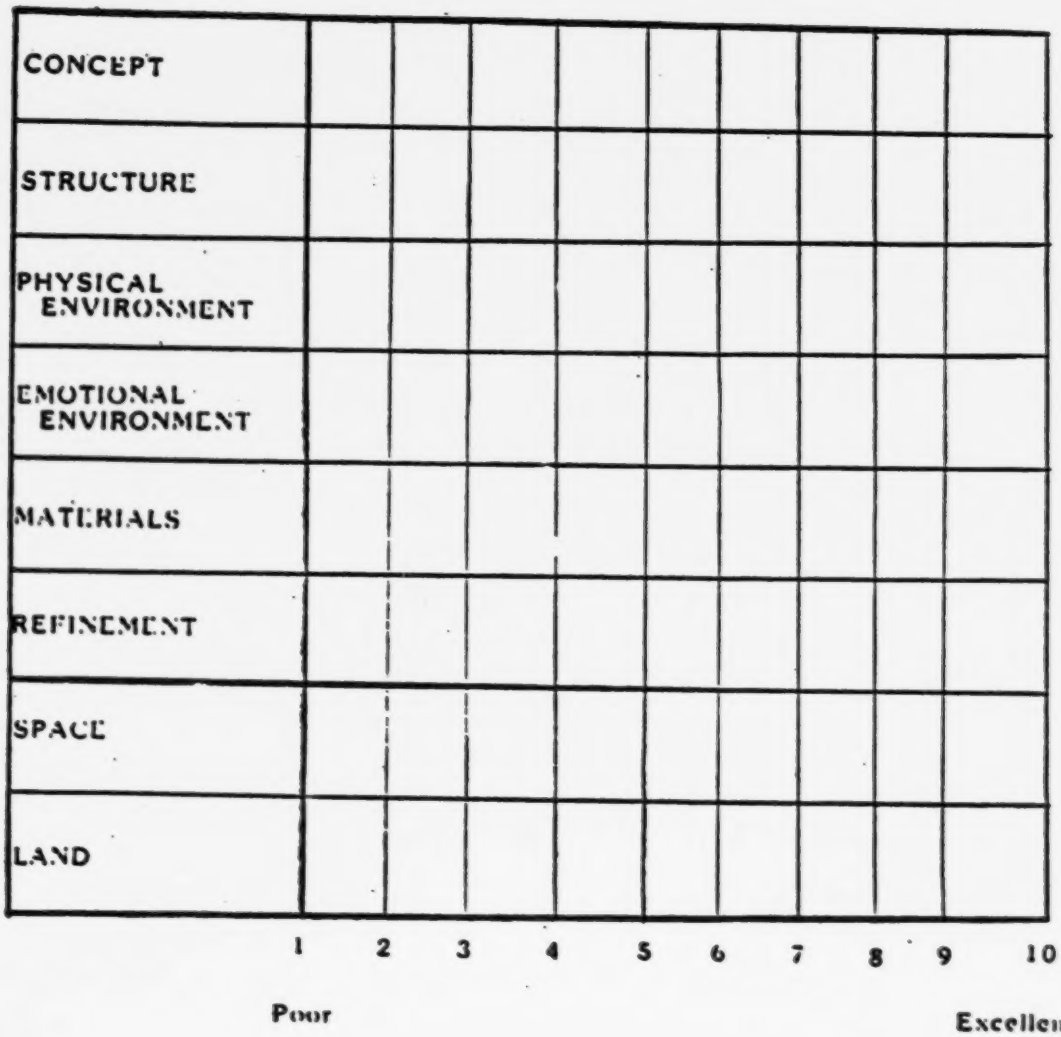
2. Collect examples of actual work to illustrate each step of the PDP.

3. Collect or produce examples of student work that show the depth and quality of solutions and the graphic standards for the work.

4. Collect/prepare the following:

   a. Site information
   b. Project program.

DESIGN QUALITY PROFILE



CONSTRUCTION PLANNING & DESIGN

MODULE: 3 : Selecting the Site

LENGTH: 5 DAYS CLUSTER

This is the first module in a series of four. Each of the four modules is designed to provide learning experiences relevant to the practices used in each step of the Project Delivery Process.

The primary purpose of the series is to provide an opportunity for students to use the PDP and to create a new low-rise structure to serve specific needs. A second purpose is to have students experience how an architectural/ engineering firm functions. It is the Project Manager's, (teacher), responsibility to organize the designers, engineers, and drafters, into productive design teams.

Selecting the best site is the key to success for any construction project. The objective of this step is to get the most value from the structure at the lowest cost. Considerable time is used to select a site because once structures are built it is hard to move them.

The simplified procedure used to select building sites includes the following steps:

1. Identify alternative sites.

2. Gather facts on each site.

3. Make a summary report to decision-makers.

4. Decision-makers select the best site.

Owners and civic leaders try to select sites that will reduce the cost of construction and the cost of operation. If they succeed the cost per unit of product or service can be minimized.

This module is designed to provide general guidelines and procedures that are useful in selecting a site for a low-rise building project. The structure can be a home, office building, retail outlet, farm structure, commercial building of any kind, etc. The teacher must decide if the project(s) designed by the team(s) is (are) student-selected or teacher-selected.

OBJECTIVES

Upon completing this learning module, each student should be able to:

1. Describe and give examples in the categories of considerations used in site selection.
2. Describe the procedure used to select sites.
3. Gather relevant information about two or more potential sites and summarize it.
4. Report summarized site information on two or more sites and make a recommendation based on the needs of the client.
5. Describe the environment and economic impact of the project for each site.

CALENDAR

DAY	ACTIVITY
1	Considerations and procedure used in selecting sites.
2	Gathering site information.
3	Organizing and preparing reports.
4	Reporting site information.
5	Making recommendations and decisions.

DAY	ACTIVITY
0	A variety of information is needed to maximize the interest and value of this module. Precede the introduction of this lesson by: 1. Obtaining client information regarding the needs for the project. Include a description of use for the building, the volume of traffic resulting, the need for utilities, requirements for location, etc. 2. Gathering information on potential sites such as shape, location, access, availability, soil conditions, size, zoning, and other relevant features. 3. Generating financial information regarding land costs, costs of extending utility services, clearing site, providing access, etc. 4. Summarizing the environmental and economic impact of the construction of the project on the site. Decide if the building project is to be a real project from a client, a student-selected project, or a teacher-assigned project. Decide in advance how you plan to organize your group. Do they work individually as a part of a large class group, or as a member of several subgroups.
1	Give presentation on "Considerations and Procedures Used to Select a Site." Include the cost of construction and cost of operation consideration. Emphasize that site selection includes four steps. Introduce a real, contrived, or assigned set of needs that a building would satisfy. Provide a list of potential sites and/or instructions so that students can identify additional sites. Take notes or keep handouts that describe the client's needs. Search classified advertisements in the newspaper, realtor listings, books, and the city for potential building sites.

DAY	ACTIVITY
2	Give presentation on, "What Information is Needed and Where is it Found." Emphasize site information and financial information. Organize class into groups of professionals to gather site information. Suggest the kinds of information needed and where to find it. Provide duplicated forms that aid the professionals in gathering and recording information. Students submit additional potential sites. Join a group of professionals. Orient yourself to the client's project, the potential sites, the recording forms, and the available data sources.
3	Give presentations on "Organizing Information" and "Preparing Reports." Include suggestions on how data is summarized. Describe how pictures, charts, graphs, and other forms of visuals are used to communicate and compare the relative features and economic characteristics of the potential sites. Direct students to gather information and begin summarizing it. Students collect site information from the sources of information provided or from actual potential sites. Record the information on forms provided by the teacher generated by the professional group.
4	Give presentation on "Reporting Site Investigation Information" and "Making Recommendations." You can demonstrate by making a report and recommendation or showing a video tape of one from last term or an actual one given by an A/E firm. Students: 1. Prepare summary reports 2. Decide on recommendation 3. Organize material to be reported 4. Prepare presentation materials.

DAY	ACTIVITY
5	1. Set up meeting where reports and recommendations are made.
	2. Identify a group of decision-makers.
	3. Start meeting.
	4. Make the decision.
	Students:
	1. Give reports and make recommendation.
	2. Select best site.

BIBLIOGRAPHY

TEXTBOOK REFERENCES:

Organizing and Preparing Reports

Walker, T., Plan Graphics. pp. 7-28.

Site Selection Procedure

Henak, Richard M., Exploring Construction Technology. pp. 50-54.

Lux, Donald, et.al., World of Construction. pp. 19-23.

APPENDIX

INSTRUCTIONAL MATERIALS:

1. Prepare transparencies that communicate the procedure and considerations used to compare alternative lots.

2. Obtain or produce a video tape of a site selection meeting.

3. Collect forms used by architects for recording, presenting, and comparing site information.

4. Prepare booklets of examples of forms for students to use in developing their own forms.

CONSTRUCTION PLANNING & DESIGN

MODULE: 4 : Designing & Engineering Low-rise Structures

LENGTH: 15 DAYS Construction CLUSTER

Designing and engineering are activities which find solutions to problems. Designing and engineering structures require a great deal of creative thinking on the part of the person in charge of developing a project. Architects and engineers are professionals who design structures.

The chief designer is hired by the owner or by civic leaders. The kind of designer is determined by the project being built. Architects are hired to design buildings and to do master planning. Engineers must have knowledge of the strengths of materials and how to analyze the forces placed on them. They design foundations, frames, and mechanical systems, and are chief designers for bridges, tunnels, pipelines, and utility systems.

A variety of factors influence the design and styling of a structure. A list of these factors include:

1. Needs of the client
2. Available resources
3. Structure size, location, and styling
4. Government regulations for the area
5. Cost.

A/Es are creative people who sort through limitations and design requirements. They work from abstract ideas and convert them into specific solutions.

Designing and engineering are not done by chance. They follow a systematic design process. A good design process includes the following phases.

1. Develop the program
2. Create preliminary ideas
3. Prepare schematics of alternative ideas
4. Develop design
5. Select best design
6. Implement the design.

This module introduces students to a design process. The designers develop a project for the site selected in Module 3. Student A/Es prepare a program for the project and follow through each of the above steps. The design process described above should be used to sequence classroom activities.

Students are to design and engineer the site, structure (including both foundation and superstructure), the mechanical systems (plumbing, climate control, communication, and transportation systems), and electrical power systems.

The class is organized like an A/E firm and students experience the conditions under which A/Es work. At least two design teams are recommended. In this way the breadth of experiences will be increased, higher quality solutions will be found, and greater personal involvement will result.

Working in design teams is more than sitting in close proximity while working on individual assignments, helping slower students or assigning a report to a group of students. It entails the following four elements:

1. Interdependence Among Members - Group work should be organized so that the division of labor, resources, and roles contribute to mutual goals and joint rewards.

2. Face-to-Face Verbal Interaction - Team members need to talk in order to plan work, to decide on assignments, brainstorm, etc., to get best use of resources and to develop the highest quality ideas.

3. Periodic Assessment - Throughout the duration of the project, members of the design team need to get together to assess progress, maintain focus, identify problems, share information, and seek assistance.

4. Group Process Training - Needs in the areas of interpersonal and small group skills and the quality of team functioning are provided by the teacher.

A few simple guidelines will help to keep the group work moving forward and to insure that each group member participates in an on-time delivery of high quality professional services.

1. Identify Objective - Objectives should be problem-centered, challenging, significant, and whenever possible, real.

2. Organize the Setting - Establish the group by assigning members (heterogeneous grouping of abilities, sex, race, etc. is preferred), use relevant titles (designers, engineers, etc.), and cast the objective into a larger setting than the task itself. For example, rather than just designing a structure, bring in the need for satisfying an owner, governmental agencies, timelines and the design standards within the A/E office.

3. Organize the Task - Each project can be divided into individual tasks. The first time students function as a team, they may have difficulty in breaking the project down and in making equitable assignments. The project director (PD) who is also the teacher may have to do the organizing or at least help the team do it.

4. Lead the Project - The project director's responsibility in leading teams is to initiate the project structure, the interdependence, establish the setting, specify the performance criteria, monitor progress, and provide aid.

5. Evaluate Progress - Both the quality of learning and of the group's level of functioning are assessed. Learning is assessed by determining the level of quality shown in presentation materials. Depth, breadth, and originality of the solution to the problem is the measure of the level of quality of the group's work. Self-assessment tools are used to identify the level of group functioning achieved by the group. Assessment tools are in the Appendix.

OBJECTIVES

Upon completion of this unit of study, the student will be able to:

1. Distinguish between the work of architects and engineers.
2. List and describe several factors that influence the design of structures.
3. Use the Project Planning process to design and engineer a low-rise structure.
4. Build study, structural, and/or mathematical model(s) to analyze the appearance, strength, function, and cost of a low-rise building.
5. Prepare materials and make a presentation of a design solution to a client.
6. Describe how A/Es can impact the quality of life through the design of structures.

CALENDAR

DAY	ACTIVITY
1-2	Introduce design teams and the project program.
3	Present creating preliminary ideas and brainstorming.
4-5	Present how to use schematics and how to make them.
6-10	As needed, present developing ideas, building study models, engineering the structure, and estimating costs.
11-14	Introduce presenting design solutions. As it is needed, provide instruction and direction in making perspective, schematic and concept drawings, and in building models.
15	Present design solutions to client and select the best one.

DAY	ACTIVITY
0	Examples of actual work by A/E would be useful in helping students see the value in applying the Project Planning (PP) process. A practicing A/E would be an excellent guest lecturer. He could describe the process and use examples of his own work on a local project to illustrate the lecture. Decide how your design firm is to be organized (design teams or departments). Design teams are recommended for single projects. They are easier to manage.
1-2	Introduce students to working in design teams. (See Introduction or Appendix.) Give presentation on "The Program." Point out the following components. 1. List of functional requirements 2. Special requirements for certain spaces 3. Room areas, uses, contents, and placement 4. Work flow 5. Site information and needs 6. Cost limitations 7. Utility requirements 8. Zoning restrictions and building code. Students gather information by using an appropriate survey instrument such as: 1. Office employee questionnaire 2. Activity matrix 3. Work flow questionnaire 4. Assumptions 5. Projections 6. Space program.

DAY	ACTIVITY
	Prepare program describing:
	1. Function a. General requirements of size, aesthetics, etc. b. Room requirements regarding sun, placement use, contents, sizes, etc.
	2. Structure a. The building height, placement on site, shape, insulation, spans, loads, etc. b. Mechanical system requirements regarding electrical power, water sewage, climate control, transportation of people, and freight, etc.
	3. Site size, topography, soil conditions, surrounding structures, traffic rerouting, material stockpiling, utilities, zoning restrictions, drainage, access to structures, parking needs, etc.
	4. Cost of land, building, and operating cost specifications.
3	Present "Creating Preliminary Ideas". Include:
	1. Making bubble diagrams
	2. Making simple elevations
	3. Introduce alternative building systems
	4. Describe how to do individual and group brainstorming.
	Design teams:
	1. Brainstorm ideas in a group.
	2. Consider alternatives by using bubble diagrams and simple elevation sketches to represent ideas.
	3. Sketch wide range of building systems.
4-5	Give presentation on "Preparing Schematics."
	Demonstrate how to make sketches to refine ideas: Bubble drawings, schematics, and scale drawings.

DAY	ACTIVITY
	Students:
	1. Select best one or two ideas.
	2. Use sketching methods to establish room arrangements, identify traffic patterns, refined sketches to show room arrangements, elevations, overall dimensions, location on the site, and access.
	3. Compare alternative ideas to the program.
6-10	Give presentation "Developing the Design." Bring out that appearance, function strength, and cost are the central concerns. A/Es use study, mathematical and structural models to analyze solutions. Architects focus on appearance and function. Engineers focus on the site, structure, and function of mechanical and electrical systems.
	Give presentation "Building and Using Study Models."
	Demonstrate materials and methods used to build models used by A/Es for in-house analysis of mass relationship, traffic flow, land contours, process routing, structural analysis, etc.
	Present how mathematics and physics are used to analyze the strength of structures, determine sizes of members, and the relationship of parts.
	Present "Cost Analysis Methods." Include how to roughly estimate cost of construction.
	The design teams develop designs in terms of appearance, function, strength, and cost. Focus is on appearance and function.
	Build necessary study models.
	Estimate rough cost of construction.

PRESENTING THE MODULE

DAY	ACTIVITY
10-14	Give presentation on "Presenting Design Solutions." The ideas of What, Why, and How presentations are made. Emphasize communications, how well solution satisfies the functional appearance, strength, and cost needs.
	Introduce the Design Quality Profile.
	Direct students to resources on:
	1. Making perspective drawings and renderings.
	2. Making schematic drawings of the floor plan and elevations.
	3. Making concept drawings to communicate structural solutions.
	4. Making and using simple models to show mass relationships, traffic flow, land contours, process routing, building systems, sub-soil conditions, mechanical systems, etc.
	Schedule presentations.
	Design teams:
	1. Plan presentation to communicate how well the solution satisfies the appearance, functional, structural, and cost specifications in the program.
	2. Organize to prepare study models, schematics, structural models, cost analysis charts, etc. for the presentation.
15	Set up meeting with client.
	Select the best solution by using a Design Quality Profile.
	Design teams:
	1. Present design solution.
	2. Select the best solution.
	3. Write a brief on why they felt the solution was the best.
	4. Use the "Design Quality Profile" as a guide.

BIBLIOGRAPHY

TEXTBOOK REFERENCES:

Creating Preliminary Ideas

Spence, W., Architecture: Design, Engineering Drawing. pp. 93-120.

Developing the Design

Spence, W., Architecture: Design, Engineering Drawing. pp. 179-232.

Estimating Costs

_____. Architects Handbook of Professional Practice. # 15 "Construction Cost Analysis", pp. 3-7.

Introduction to the Project

_____. Architects Handbook of Professional Practice. # 11 "Project Procedures", pp. 6-9.

Preparing the Presentation

Austin, Richard L., Report Graphics. pp. 1-29.

Spence, W., Architecture: Design, Engineering Drawing. pp. 390-410.

APPENDIX

1. Prepare media that visualizes the steps in the design process and the specific techniques and devices used to facilitate designing structures.

2. Gather examples of student work or actual samples of work done by A/E that was used at each step of the Project Planning process. Forms, procedures, and techniques used in A/Es offices are of considerable value in validating the simulated practices.

3. References describing kinds of foundations, parking lot and driveway cross sections and layouts, electrical, plumbing, and climate control, and earth-moving reference books.

SPECIAL EQUIPMENT AND SUPPLIES:

The following materials are not required but will provide better learning opportunities for the students.

1. Model building tools

2. Variety of model building supplies

3. Drawing medium with standard borders and title blocks

4. Freehand drawing pencils, erasers, scales, felt markers, etc.

5. Drafting tables

6. Work surfaces for constructing models

7. Audio/visual presentation equipment

APPENDIX

GROUP FUNCTIONING PROFILE

Project Name: _____

Leader: _____ Group #: _____

Recorder: _____ Date: _____

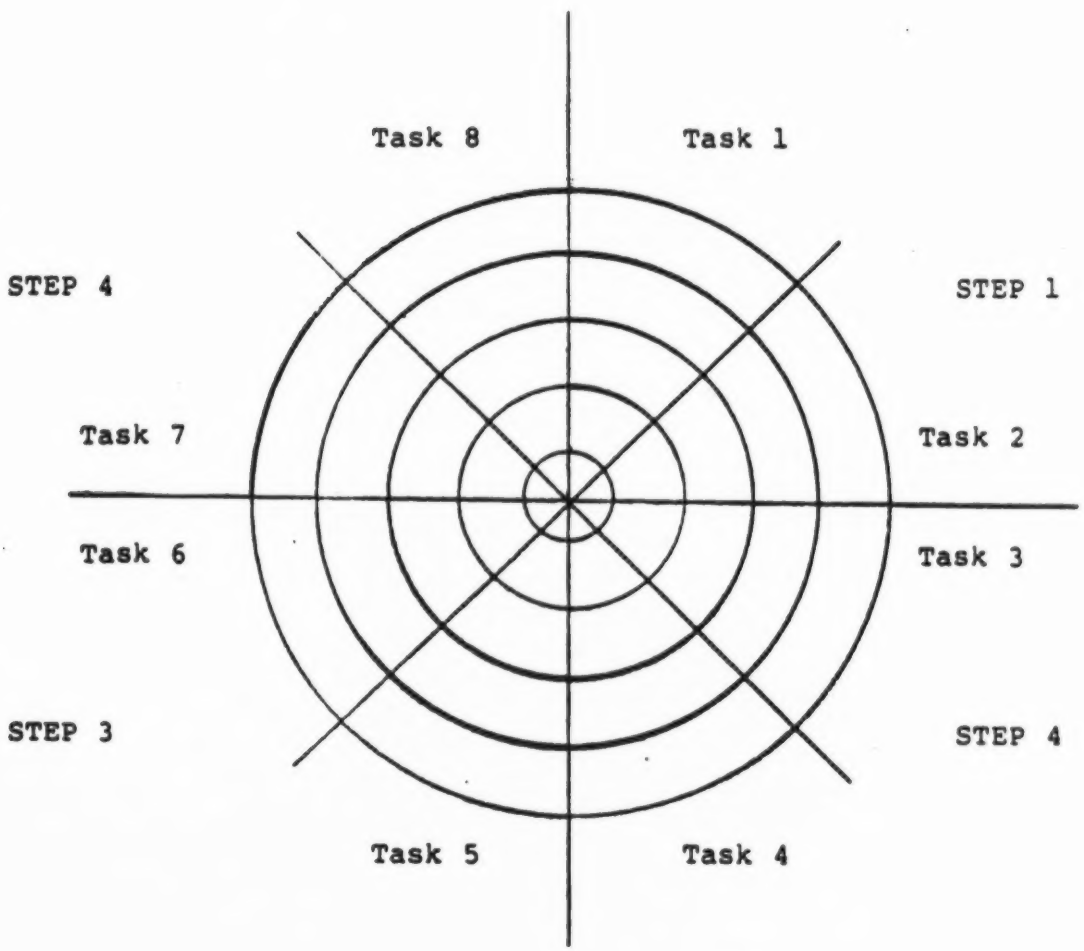
Stop Action: _____ Group Rating: ___

Members: _____ Project Rating: ____

_____

_____

_____



APPENDIX

FIVE-MINUTE CHECK WORKSHEET - STEP 1

Organizing the Project

How well do you think the group did in **Identifying the Tasks** and in **Assigning Work?**

1	2	3	4	5
Poor		Average		Excellent

1. **Poor** - Many people were not involved. The group discussion is really off target.
2. **Fair** - Could be a lot better. Some people are not involved. The group discussion wanders most of the time.
3. **Average** - Most people are involved. The group discussion works well sometimes.
4. **Good** - All people are involved. The group discussion is on target most of the time.
5. **Excellent** - Everyone seems very involved. The group discussion is on target all of the time.

Comments or Suggestions:

CONSTRUCTION PLANNING & DESIGN

MODULE: 5 : Preparing Working Drawings

LENGTH: 15 DAYS Construction CLUSTER

Working drawings for construction are made after designing and engineering are complete. These drawings are made by the A/E or by drafters in the production department of an A/E office. The drawings are fully detailed and dimensioned.

Drawings for small structures are made and approved by the client. Large projects like dams and bridges are complex. Working drawings are not made until after the decision to build has been made.

A set of working drawings for a building usually includes:

1. Plot plan
2. Foundation plan
3. Floor plan
4. Electrical plan
5. Climate control plan
6. Plumbing plan
7. Exterior elevations
8. Structural details
9. Finish details.

In this module students learn to make working drawings for the low-rise structure designed earlier. In this module, the teacher is the Project Manager and is orienting the drafters to a new office. The drafters must pass a "Graphics Standards Performance Test" as a part of their orientation. The first four days are used for the orientation. Afterwards, the drafters are assigned one or more drawings.

OBJECTIVES

Upon completing this learning module, each student should be able to:

1. Describe two kinds of construction documents and distinguish between them.
2. Use drafting equipment, supplies and techniques to pass a "Graphics Standards Performance Test" designed by the teacher.
3. Complete at least two working drawings for a low-rise structure.
4. Assemble the set of drawings made by the students.
5. Describe job titles, general duties, and working conditions for project managers and production drafters in an A/E firm.

CALENDAR

DAY	ACTIVITY
1	Introduce, "Construction Documents."
2	Demonstrate techniques of using drafting tables, tools, and supplies.
3-4	Introduce "Graphics Standards" and why they are needed.
5-13	Review the kinds of drawings found in a set of drawings, organize the "Production Department," and make drawing assignments to drafters.
14	Describe "Schedules." Include kinds and how to prepare them.
15	Assemble the "set" of drawings.

PRESENTING THE MODULE

DAY	ACTIVITY
0	Determine the graphic standards for the drawing. Develop a Graphic Standards Manual and duplicate one for each student, or select a reference that includes the standards, such as your textbook. Include in the manual or reference a set of drawings that illustrate the graphic standards in use. Collect sets of drawings that have high and low standards of graphics. Decide how the team of drafters are organized and what assignments are to be made.
1	Give presentation: "Orientation to Construction Documents." Include: 1. Distinction between drawings and specifications 2. Describe the kinds of drawings 3. Describe the arrangement of drawings 4. Introduce graphic standards. Guide drafters through the guided observation activity in which they identify kinds of drawings, point out both high and low graphic standards. Set the stage. Tell students they are new workers hired to complete the construction documents for a project. The activities in the first few days is an orientation. The purpose is to develop a consistent style for the firm's graphics.
2	Introduce "Graphic Standards Manual" (or equivalent). See Appendix. Included is the index of lines, symbols, lettering, and dimensioning standards. Demonstrate techniques for placing medium on drafting table and using tools and supplies to draw geometric shapes, or make a simple drawing like Figure 5-33 or 5-34 in Spence's textbook.

DAY	ACTIVITY
3-4	Direct students to do Phase I of their "Graphic Standards Performance Test" (GSPT) designed to determine their level of skill in using a drafting machine, compass, pencil, triangle, and templates. This phase involves doing the line work on a simple drawing similar to the one found in Spence's textbook, pg. 130, Figure 5-34. Phase II of the GSPT includes doing lettering like that found on p. 135 in Figure 5-41 in Spence's textbook.
5-13	Give presentation on kinds and arrangements of drawings that make up a working drawing. Organize Production Department to complete the construction documents for the low-rise projects that were designed in Module V. Make production drawing assignments. Each drafter should have 2-3 drawings to make. Include site, foundation, floor, elevation, structural, engineering plans, details, and schedules.
14	Describe the kinds of schedules and how to prepare them. Include finish, window, and door schedules.
15	Demonstrate: "Assembling the Set of Working Drawings." Direct students to complete the drawings.

BIBLIOGRAPHY

TEXTBOOK REFERENCES:

Graphic Standards

Spence, W., Architecture: Design, Engineering Drawing. pp. 122-135.

Orientation to Construction Documents

Spence, W., Architecture: Design, Engineering Drawing. pp. 169-178.

Schedules

Spence, W., Architecture: Design, Engineering Drawing. pp. 428-437.

Working Drawings

Spence, W., Architecture: Design, Engineering Drawing. pp. 141-178.

APPENDIX

INSTRUCTIONAL MATERIALS:

1. Visuals that communicate the concepts involved in organizing an A/E production department, graphic standards, construction documents, and drafting tools, supplies, and techniques.

2. Collect one or more sets of drawings, graphic standards models, work management charts, etc. that model good and poor A/E practices.

The "Graphic Standards Manual" consists of an assortment of good examples of drafting room practices. It should consist of the following sections as a minimum. They are:

1. Drawings that make up a "set"
   a. Site Plan
   b. Footing and Foundation Plan
   c. Floor Plan w/Electrical and Plumbing Layouts
   d. Elevations
   e. Wall Section Details
   f. Window, Finish and Door Schedules, etc.

2. Lines

3. Dimensioning

4. Lettering

5. Architectural Symbols

You may want to take illustrations from the textbook and use them in the "Manual" or use other sources. Many good examples can be found in Plan Graphics by Walker.

SPECIAL EQUIPMENT AND SUPPLIES:

Beyond standard drawing tables, machines, etc., the following equipment and supplies help to provide better learning opportunities.

1. Drafting tables with drafting machines

2. Wide assortment of templates

3. Kroy lettering machine and variety of type disks

4. Diazo printer

MODULE: 6 : Writing Specifications

LENGTH: 5 DAYS Construction CLUSTER

Not all parts of a building can be clearly represented by drawings. For example: The color, texture and method of applying paint are difficult to show on a drawing. The task of describing materials and construction standards is much easier to describe in words. These descriptions are found in the specifications. They are written guides to the builder.

Specifications are first used by contractors to estimate and bid the project.

There are three sections to the "Book of Specifications." They are:

1. Conditions of the Contract that describes the relationships that exist between the contractor and the owner, time for completion, etc.

2. General Scope of the Work includes a description of the work to be completed and responsibilities of the contractor.

3. Construction Standards describe the materials, equipment, and methods that are to be used in building the structure and in completing the site. The section is divided into 16 divisions.

The activities in this module provide students with an opportunity to write specifications for the low-rise structure drawn in Module 5.

OBJECTIVES

Upon completing this learning module, each student should be able to:

1. Describe the specification booklet by including the sections of Conditions, General Scope of Work, and Construction Standards, and by giving an example of each section.

2. Determine through negotiation the Conditions, and the General Scope of Work for a construction project.

3. Specify the Construction Standards by including materials, equipment, and methods for use in a low-rise structure.

CALENDAR

DAY	ACTIVITY
1	Describe the "Book of Specifications" and the information found in it.
2	Describe and write the "Conditions" section for the low-rise structure.
3	Describe and write the "General Scope of Work" section for the low-rise structure.
4	Describe and write the "Construction Standards" section for the low-rise structure.
5	Assemble the "Book of Specifications."

DAY	ACTIVITY
0	Prepare all forms needed to prepare specifications. If it is convenient, you may choose to work Module 6 activities into the Module 5 activities. Drafters who get done with their drawings early can be scheduled to write the specifications. Presentations can be given during the last week of Module 5. Drafters who have not finished their drawings can complete them while those who have finished them can write specifications.
1	Introduce the class to **WHAT** is a specifications booklet, **WHY** we have them, and **HOW** they are written. Describe the various sections and the kinds of information found in each section. Divide the drafters into groups of 3-5. Provide them with a specification booklet. Direct them to find an example of a Condition, Scope of Work, and Construction Standard.
2	Give presentation on conditions. Include a range of options from which to choose. Distinguish between general and special conditions. Guide students through a role playing activity in which the A/E and client decide on the conditions.
3	Give a presentation on "Scope of Work." Include the idea of starting and finishing dates, methods of payment, penalty clauses, how to issue a change order, and a statement of rights and responsibilities of owner and contractor. Direct a role playing activity in which students act as clients and specification writers to decide on the scope of work.
4	Present the concept of "Construction Standards." Include the materials, equipment, and methods used to build the project. Briefly go over an outline and example set of construction standards that include the 11 divisions. Organize the students to write various sections of the construction standards.

PRESENTING THE MODULE

DAY	ACTIVITY
5	Describe the word processing and booklet binding equipment available. Provide models of a specification booklet that illustrates the graphical standards of the A/E firm. Organize and direct students to prepare a specification booklet for the low-rise structure drawn in Module 5.

BIBLIOGRAPHY

TEXTBOOK REFERENCES:

_____. Architects Handbook of Professional Practice. # 14 "Construction Documents", pp. 3-11.

Spence, W., Architecture: Design, Engineering Drawing. pp. 163-167.

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APPENDIX

INSTRUCTIONAL MATERIALS:

1. Visuals that illustrate the concept and component parts of specification writing.

2. Collect specification booklets for a variety of construction projects.

MODULE: 6 : Designing Civil Structures

LENGTH: 25 DAYS Construction CLUSTER

This module is designed to provide engineering experiences in engineering a wide range of civil projects. Design teams are to be assigned to various facets of a regional development project. In this project:

1. A dam is placed in a river to form a reservoir.
2. Water from the reservoir must be moved to a water treatment plant and to the users, and sewage moved to the waste water treatment plant.
3. A high-rise apartment structure will be built near the reservoir.
4. Power transmission towers, lines, and substation must be built to transport power from the power house at the dam.
5. Roadways will be needed to provide automobile, truck and train access to the businesses, housing units in the new area.
6. A bridge is needed to cross the river.
7. A tunnel is needed to pass through a high, rocky ridge between an existing city and the new development.

The class is to be divided into design teams. One of the seven civil projects are assigned to each team. A topographical map and a model of the profile of the region is provided. A soil survey and relevant data for three alternative sites is provided for each project. The program for each structure is provided.

The design teams' tasks are:

1. Select the best site.
2. Prepare two schematic designs that satisfy the program.
3. Develop one of the designs.
4. Build study models of the structures.

5. Build structural models that illustrate the foundations and structural details.

6. Make presentation drawings and schematics for the project.

7. Present the designs for the structure.

All of the structures have to be blended into a coordinated and compatible development.

OBJECTIVES

Upon completing this learning module each student should be able to:

1. Describe the responsibilities of a project manager, design team leader, and design team member.

2. Describe the nature and purpose of status reports, graphic standards manual, project reviews, and employee evaluation reports.

3. Gather and use site data and program information to rank order alternate sites.

4. Work cooperatively as a design team leader or member to design a high-rise or civil project and produce two schematic designs, develop one design, build study and structural models, make presentation drawings, and present the design for the structure.

5. Describe how designers of large and small projects impact a region's economy, environment, culture, and activities.

PRESENTING THE MODULE

DAY	ACTIVITY
0	Most of the Project Manager's (teacher) work for this module is done before the project begins. Well before the Module is implemented you need to:

1. Prepare topographical map of approximately 10 x 20 miles for the development area.

2. Build a model of the land contour representing the map on a 3' X 6' sheet of plywood.

3. Prepare a soil survey report for the development area.

4. Develop site information for three alternate sites for each of the seven projects. Include the location, boundaries, topographical map, soil survey, cost, zoning, and owners.

5. Prepare weekly Project Status Reports for each group's weekly reports.

6. Develop a Site Evaluation Work Sheet for each design team.

7. Graphics Standards Manual.

1 Introduce the "Resort City" development project. Provide:

1. A description of the development area. Review the topographical map and model.

2. Describe the projects that our firm is to deliver. They are:

   a. A high-rise apartment structure.
   b. A dam.
   c. A bridge.
   d. Roadways.
   e. Electrical power transmission lines and a substation.
   f. Tunnels for a highway and a railroad.
   g. Pipelines to move water from the reservoir to the water treatment systems and the users, to collect sewage for the treatment plant, and remove surface water.

3. Describe the kind of professional service that is to be delivered.

DAY	ACTIVITY
2	Organize the A/E firm by: 1. Naming the firm. 2. Identifying the Design Team Leaders (DTL). 3. Assign the project to the DTL. 4. Have the DTL recruit and hire the members of the design team.
3	Introduce designers to the "Project Management Systems." Review the following: 1. Project Delivery Schedule - Developed by Project Manager (PM). 2. Project Status Reports - Developed by PM completed by DTL. 3. Graphics Standards Manual. 4. Provide each team with the project program for their individual projects. 5. The design team's tasks include: a. Selecting the best site for the overall project. b. Prepare two schematic designs for each program. c. Develop two designs. d. Build study models of the individual projects. e. Build structural models of individual projects. f. Make presentation drawings. g. Present alternate designs.
4	Provide "Alternate Site Information" for three sites for each project. Include location boundaries, soil survey, cost, zoning, and owner's names. The remainder must be gathered and recorded by the design team. Direct students to gather other relevant data. Go over the Site Evaluation Worksheet.

DAY	ACTIVITY
5	Describe "Project Reviews." 1. On Monday or first day of week. 2. Led by the PM. 3. Purpose is to coordinate design effort, report progress, use group problem-solving method to aid individuals, review project schedule, make decisions that effect everyone, and provide additional information needed to complete the project. 4. The first group decision involves selecting the sites.
6	First "Project Review." Purpose: Select the best sites for each project. The sites selected should be the best compromise for the overall goal for the "Resort City" Development Project.
7-22	Manage the delivery by facilitating student work. Provide, encouragement, direction, and resources to complete their professional services.
23	Give design presentations and evaluate each other's work.
24-25	Give a semester examination and wrap up the terms work.

BIBLIOGRAPHY

TEXTBOOK REFERENCES:

Writing Specifications

_____. Architects Handbook of Professional Practice. # 14 "Construction Documents - Specifications", pp. 3-11.

Spence, W., Architecture: Design, Engineering Drawing. pp. 163-167.

APPENDIX

INSTRUCTIONAL MATERIALS:

1. Topographical map of development area.
2. Model of land contour representing the development area.
3. Soil survey report for development area.
4. Site information on each alternative site that includes a soil survey and profile, location, boundaries topographical map, land cost, zoning, and ownership.
5. Weekly Project Status Report forms for the Design Team Leader.
6. Site Evaluation Work Sheets for each design team.
7. Employee Evaluation Report.
8. Graphics Standards Manual.
9. References that provide a variety of designs, engineering principles, tables, formulas, and approaches to designing bridges, roadways, dams, tunnels, pipelines, and towers.

EQUIPMENT AND SUPPLIES:

1. Model building tools and supplies
2. Sketching and drafting tools and supplies
3. Perspective drafting boards
4. Transparency making equipment and supplies.

PROJECT STATUS CHART

Firm:

Project Name: _____

Report Number: _____

Date: _____

Task #	Phase	Per.	Date	Percent Complete 0 25 50 75 100

% of Project Completed = $\frac{\Sigma(\%\text{ of Task Complete})}{\text{Number of Tasks}}$

APPENDIX

EMPLOYEE EVALUATION REPORT

Name _____ Position _____

Evaluator _____ Date _____

Performance	Excellant *	Good *	Average *	Poor *	Description
Quality of Work					
Knowledge of Work					
Volume of Work					
Initiative					
Judgement					
Cooperation/ Dependability					
Client/Colleague Relationships					
Potential					